

Applications of MODIS fluorescence line height measurements to monitor water quality trends and algal bloom activity in coastal and estuarine waters.

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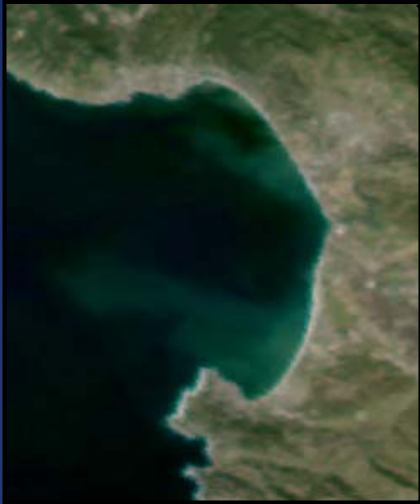


Aims

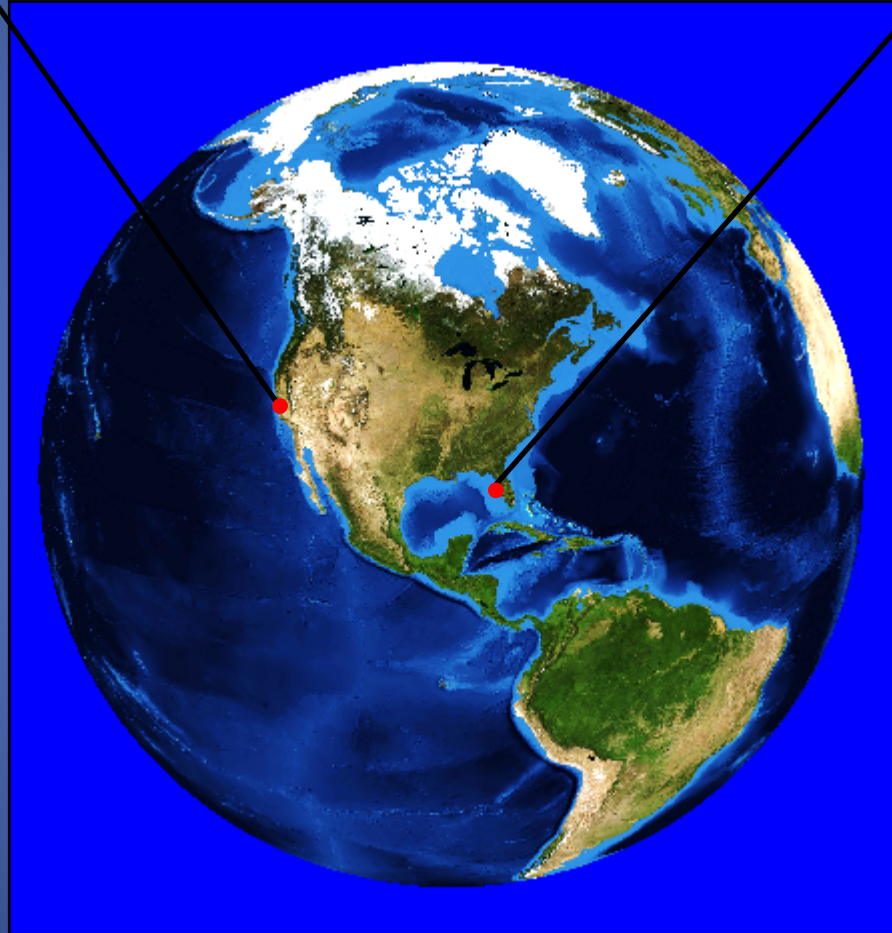
- Assess the use of MODIS FLH to ...
 - Assess the use of MODIS FLH to monitor water quality trends in Tampa Bay, Florida
 - Illustrate the annual variability of bloom activity in Monterey Bay, California

Study Sites

Monterey Bay, CA

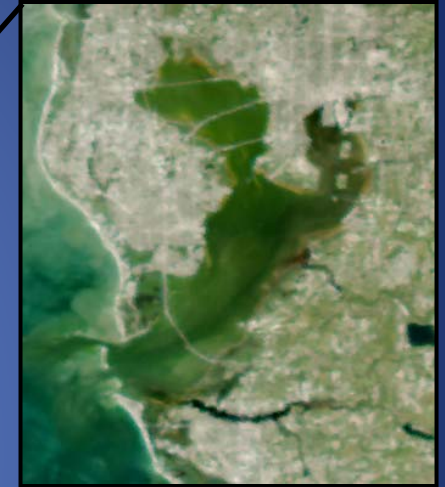


MODIS Aqua
January 21, 2011



NASA GSFC (2004), Ryan (2006)

Tampa Bay, FL

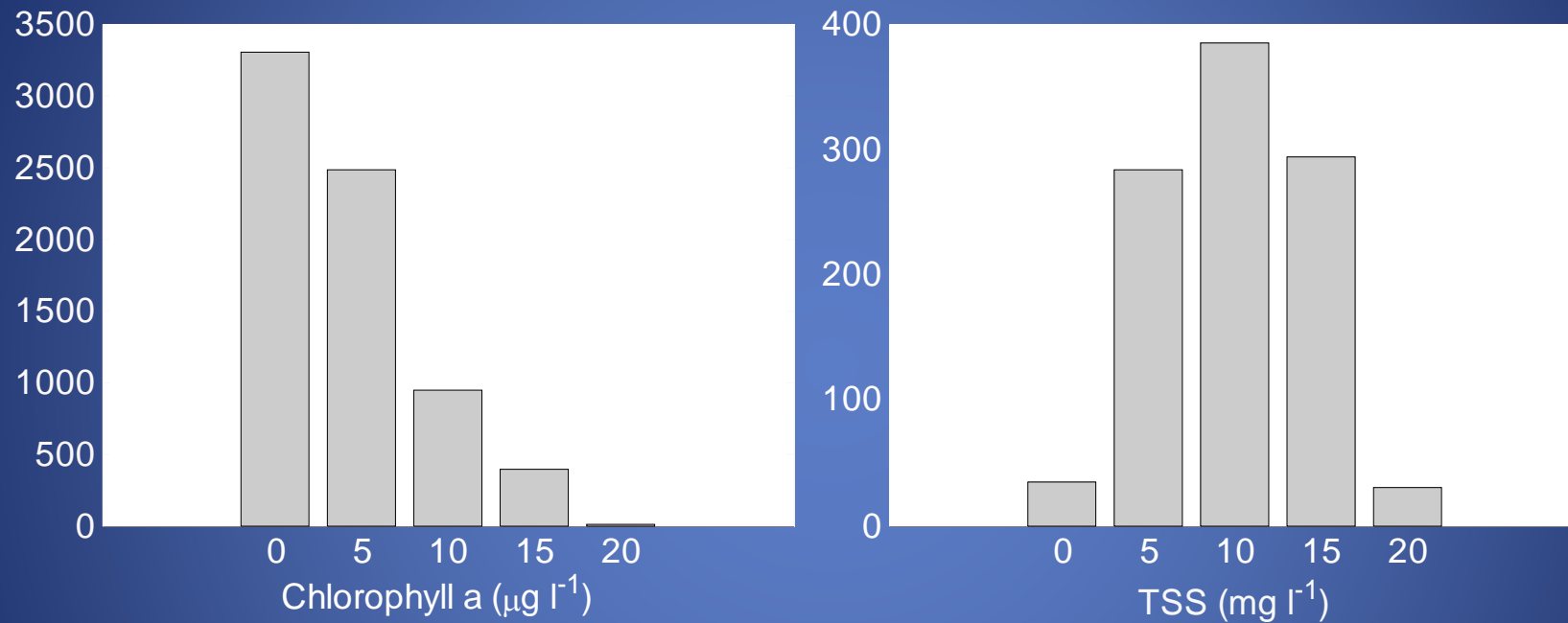


MODIS Aqua
October 15, 2003

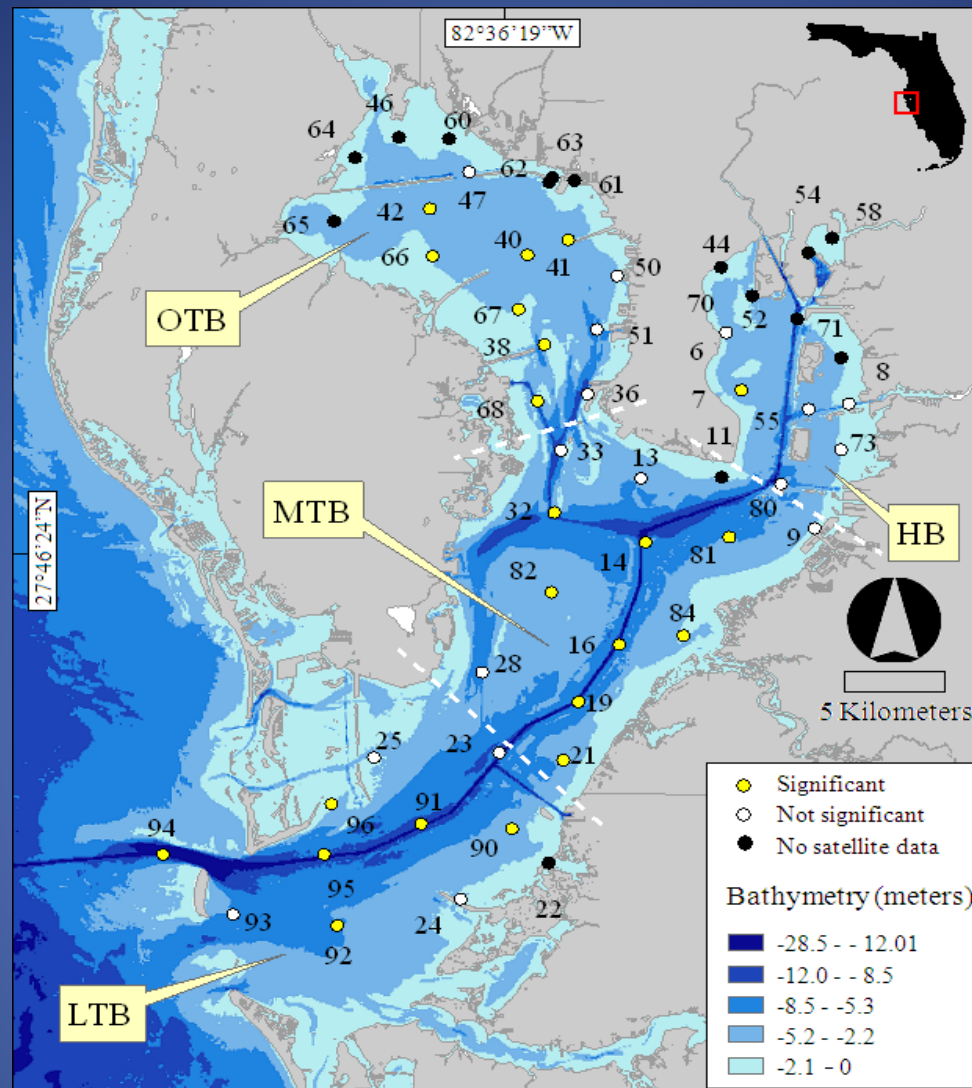
MODIS Processing

- MODIS Aqua files processed to Level 3 in SeaDAS 6.4
 - Tampa Bay
 - Default atmospheric correction (Gordon and Wang, 1994; Strumpf et al., 2003)
 - Monterey Bay
 - 250-m aerosol retrievals extrapolated to the visible from 859 nm band (Kahn et al., 2001; Franz et al., 2006)
 - Default land, cloud and saturated radiance masks applied
 - Further manual QA/QC process to remove images with cloud contamination and severe scan angle
- Satellite x *in situ* correlations and multivariate analysis with water quality parameters (Tampa Bay)
- Annual and seasonal averages of FLH products

Tampa Bay, Florida

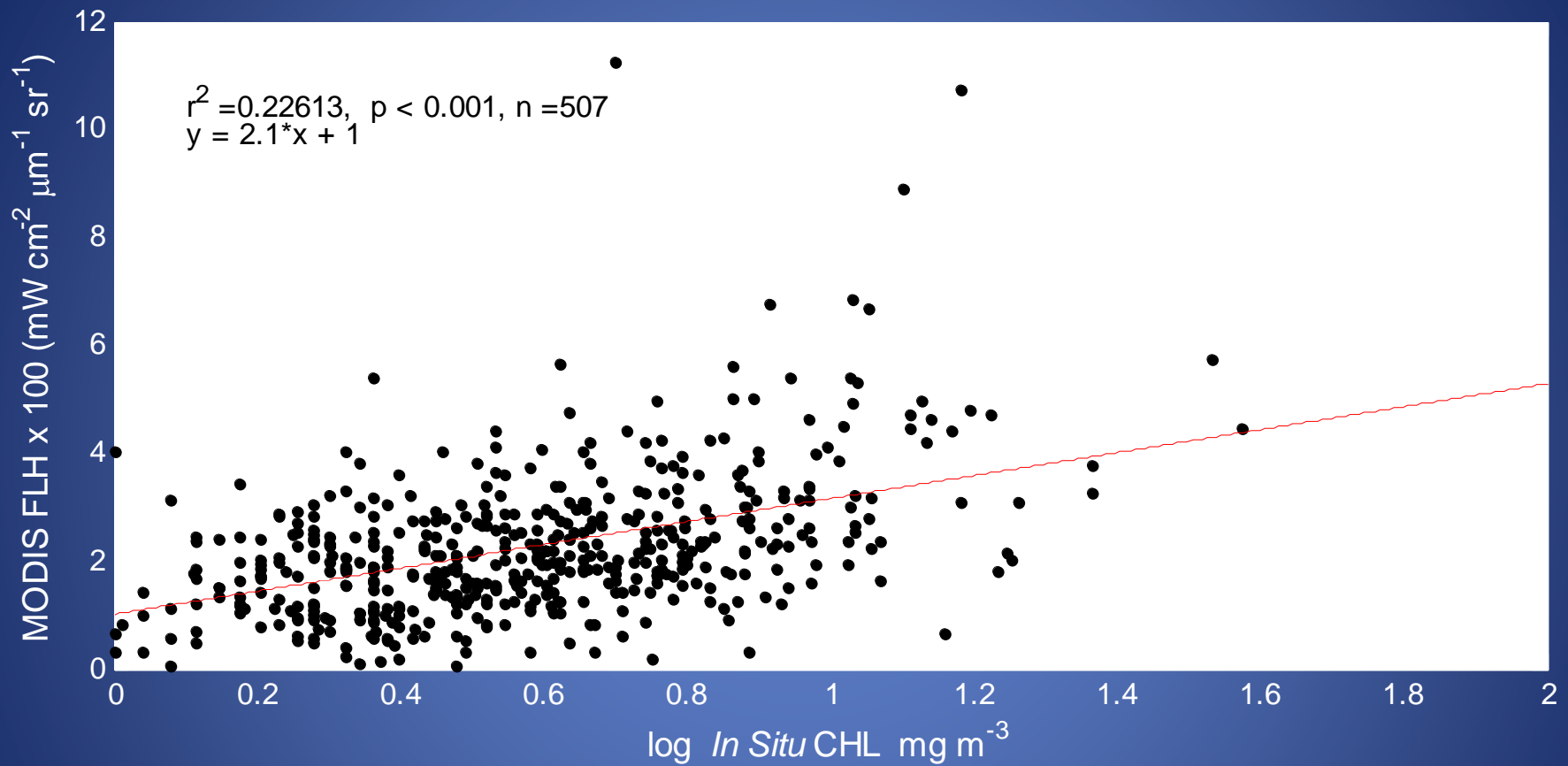


7552 in situ measurements of chlorophyll a and total suspended solids (TSS), 2003-2011



Results – Significant match-ups by site between MODIS FLH and in situ chl- α

Map of Tampa Bay, Florida (U.S.A.) showing the 54 the stations monitored by the Environmental Protection Commission of Hillsborough County (EPCEC)



Results – Pooled, bay-wide correlations.

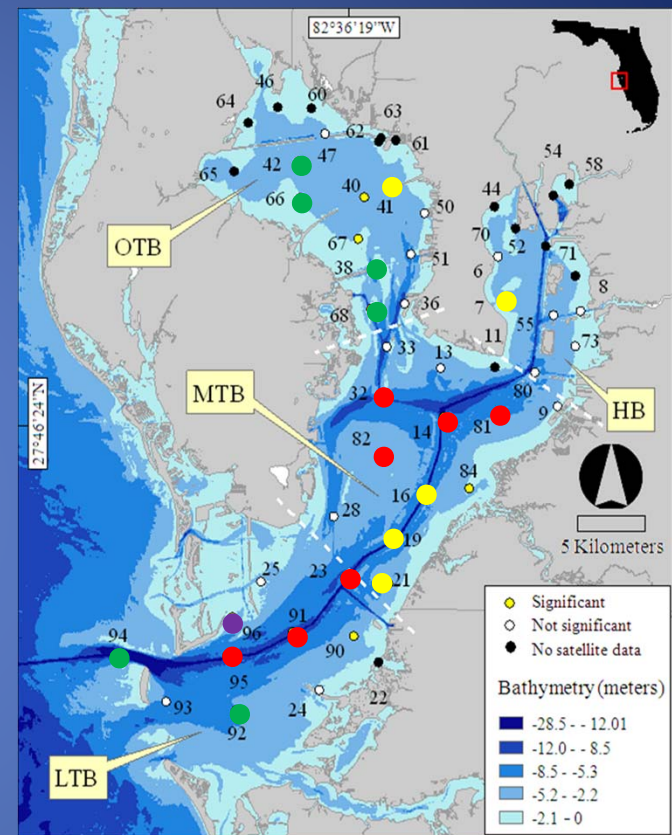
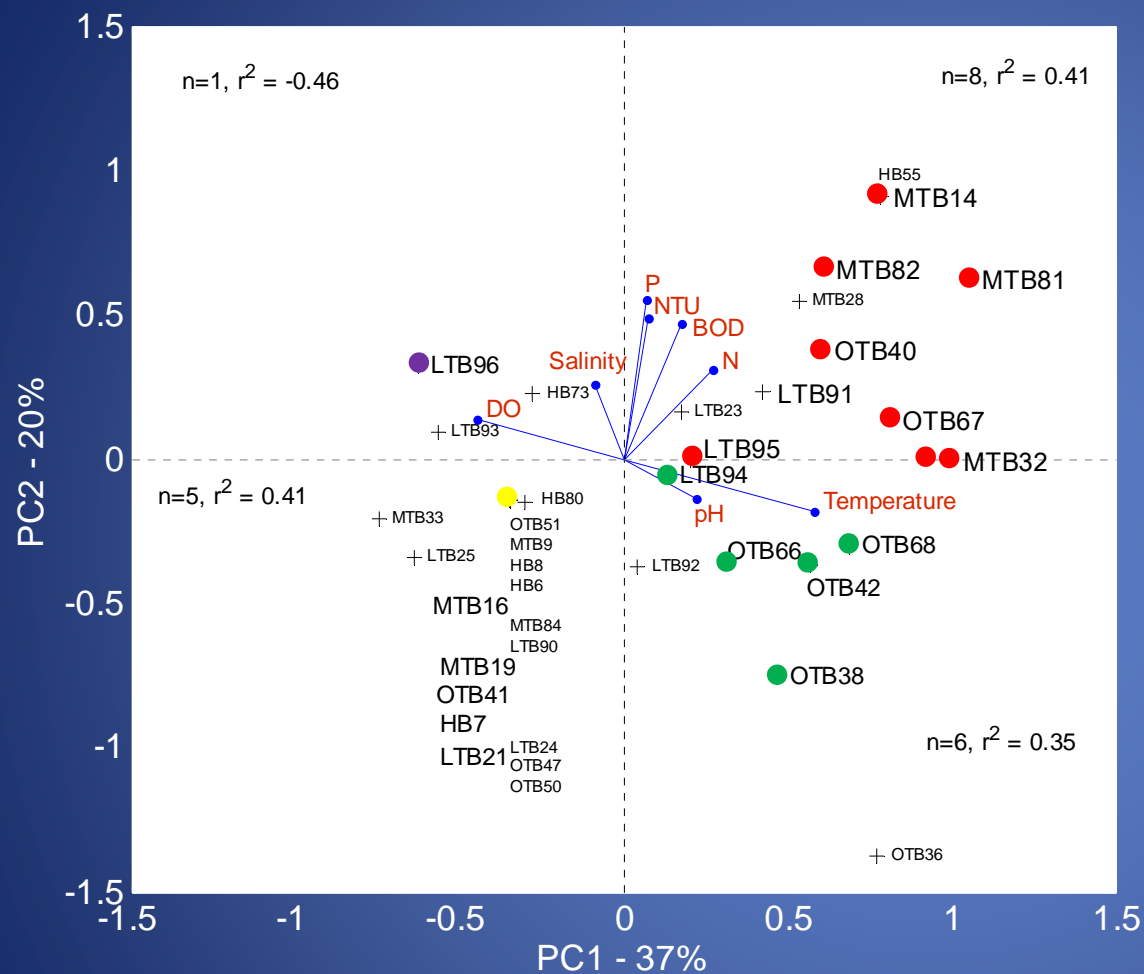
– Correlations (MODIS FLH x in situ chlorophyll-α) for all significant sites.

Results – Correlations
(MODIS FLH x in situ
chlorophyll- α) for significant
individual sites and
subregions.

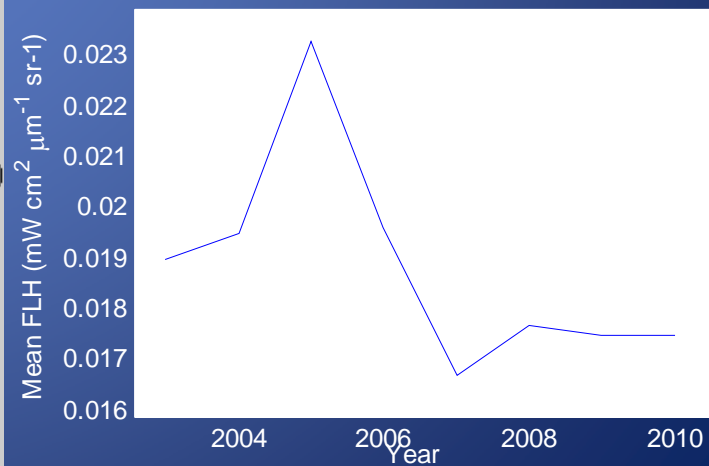
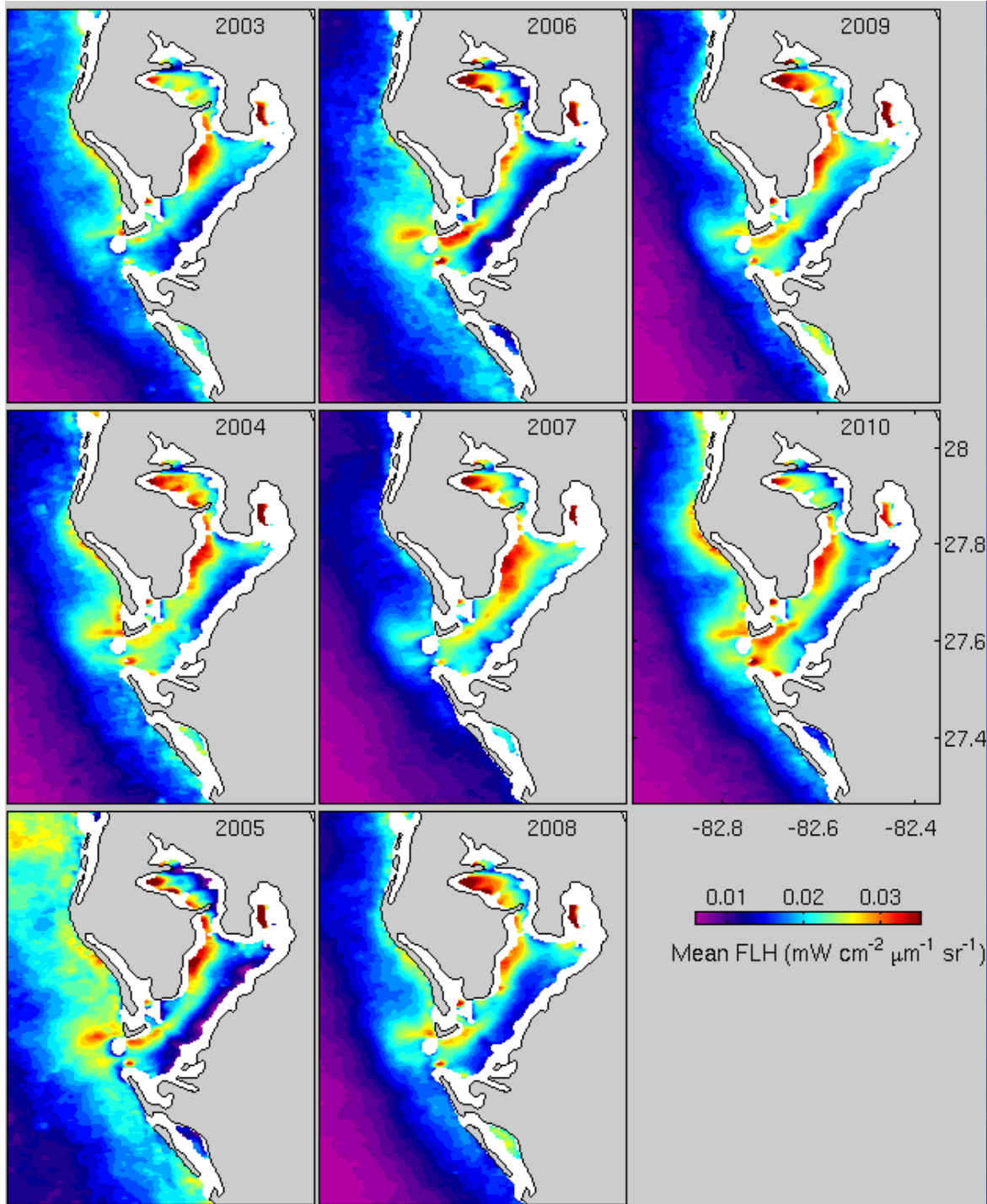
Individual sites

- r^2 ranged from 0.67
($n=28$, $p<0.01$) to 0.22
($n=25$, $p=0.016$)
- Best sites were MTB14,
HB7, OTB68 and MTB32.

Station	Distance to structure (m)	Depth (m)	Distance to Shore (m)	r^2	n	NTU
MTB14	5600	7.4	5,600	0.67**	28	2.05
HB7	1180	3.5	1,180	0.64**	11	4.53
OTB68	1530	4.8	1,530	0.49**	13	2.62
MTB32	3000	7.5	3,000	0.48**	28	2.94
LTB96 †	624	2.3	7,578	0.46*	12	3.56
OTB40	72	4.8	4,620	0.44**	28	2.74
OTB41	110	3.5	2,300	0.43**	15	2.96
OTB67	72	2.5	2,360	0.42**	26	3.19
OTB38	590	2.3	2,676	0.40**	23	2.61
MTB81	3520	7.5	3,520	0.38**	23	2.65
MTB82	5130	3.7	5,130	0.37**	34	2.28
MTB21	1765	4.9	1,765	0.35*	16	2.79
MTB19	2800	7.8	2,800	0.34**	21	2.14
LTB92	5080	5.8	5,940	0.34**	32	2.45
LTB90	1860	4.3	1,860	0.31*	16	2.81
MTB84	1150	1.8	1,150	0.29*	15	3.88
MTB16	2800	7.5	2,800	0.29**	28	2.29
LTB94	800	3.6	2,100	0.28**	38	2.63
LTB95	1890	8.2	8,654	0.26**	25	2.75
OTB42	1638	3.4	1,638	0.26*	18	3.31
LTB91	4290	9.1	4,290	0.23**	33	2.01
OTB66	2010	2.6	2,010	0.23*	25	3.63



Results – Principle component analysis of the correlations between FLH and the eight water quality sampling parameters by site.



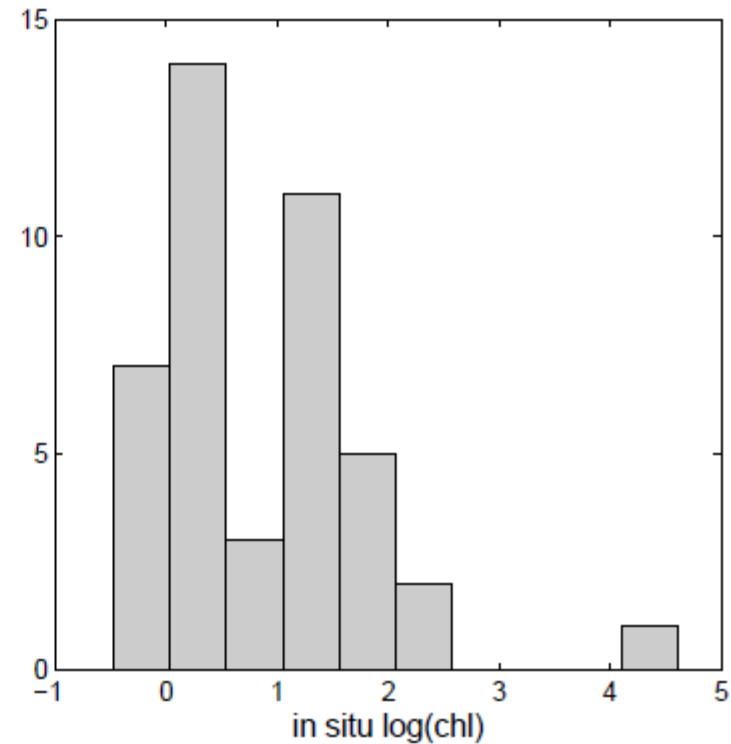
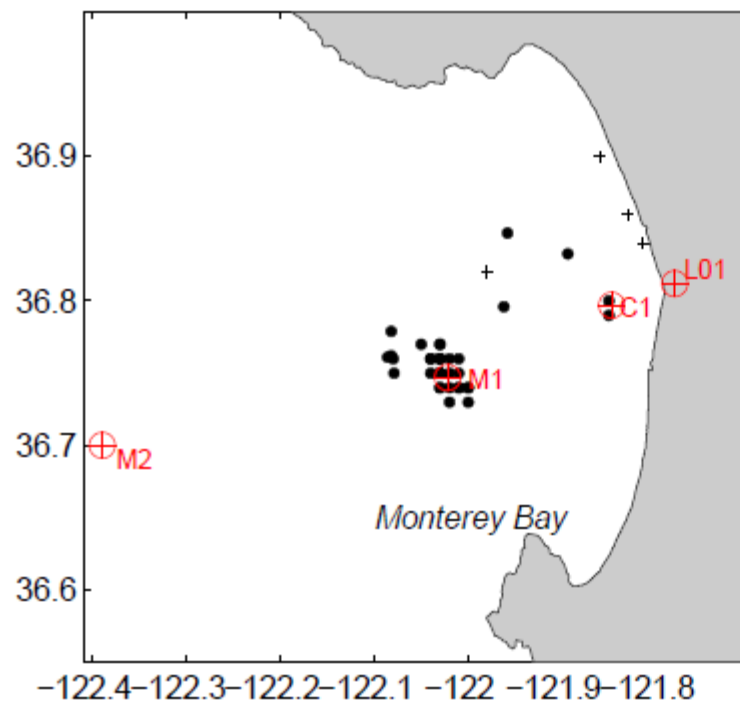


Figure 4.2: Left panel, the location of extractive chlorophyll sampling location (dots) and in situ spectral measurements (crosses). The location of time-series mooring locations as red markers. Right panel, the frequency distribution of log-transformed in situ chl a data.

Monterey Bay in situ chlorophyll -a

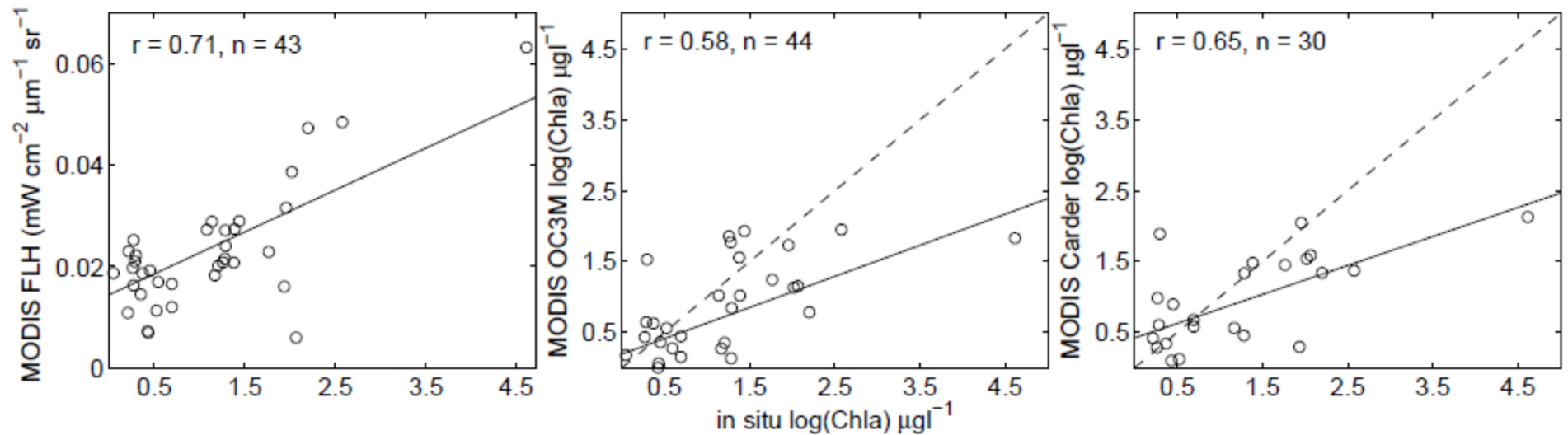
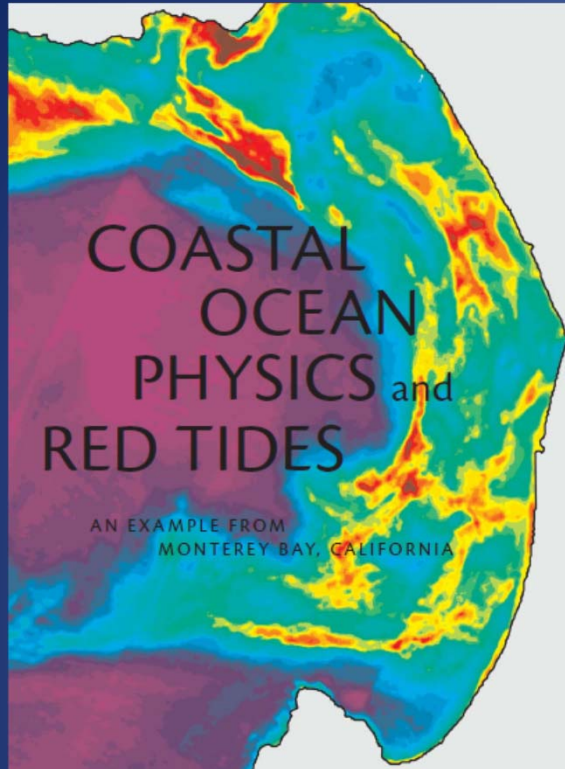


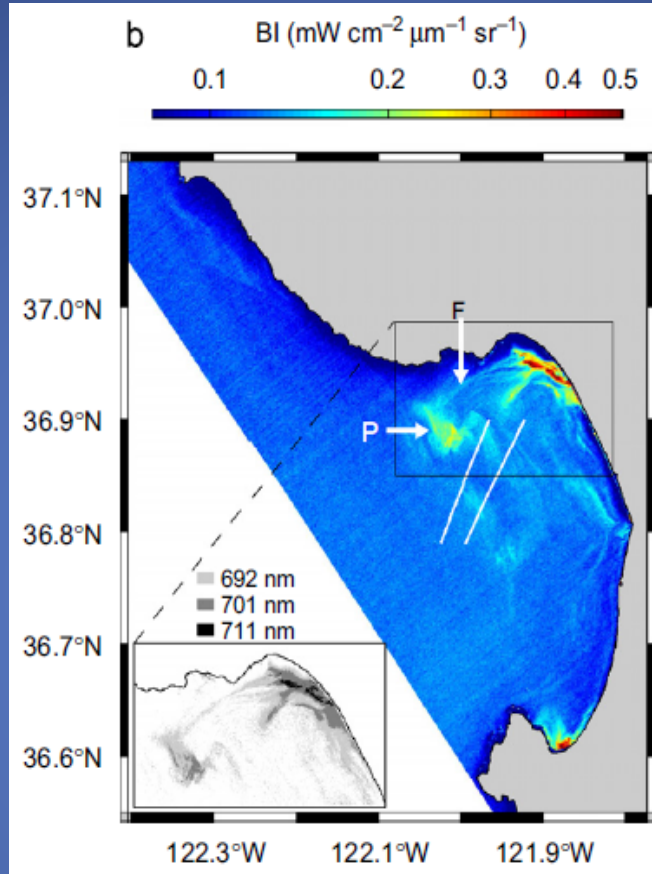
Figure 4.3: The relationships between FLH (left) OC3M chl a (middle) and Carder chl a (right) and log in situ chl a concentration. The best-fit line (solid) and the 1:1 line (dashed) are superposed.

In situ comparison with MODIS FLH and OC3M

Dinoflagellate Bloom activity in Monterey Bay



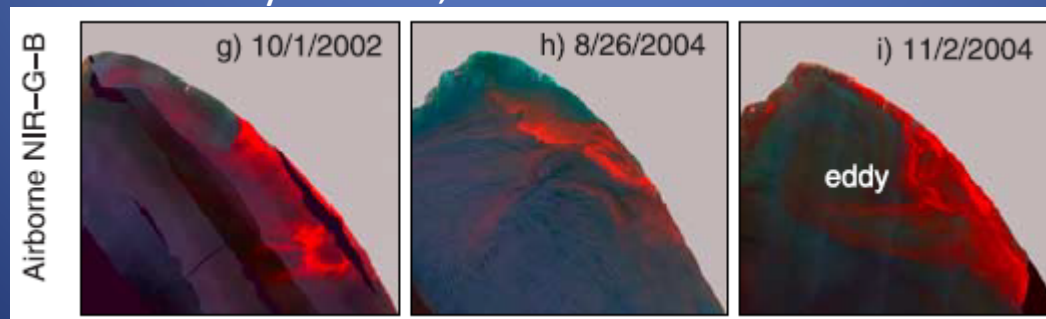
Ryan et al., 2005



Ryan et al., 2009

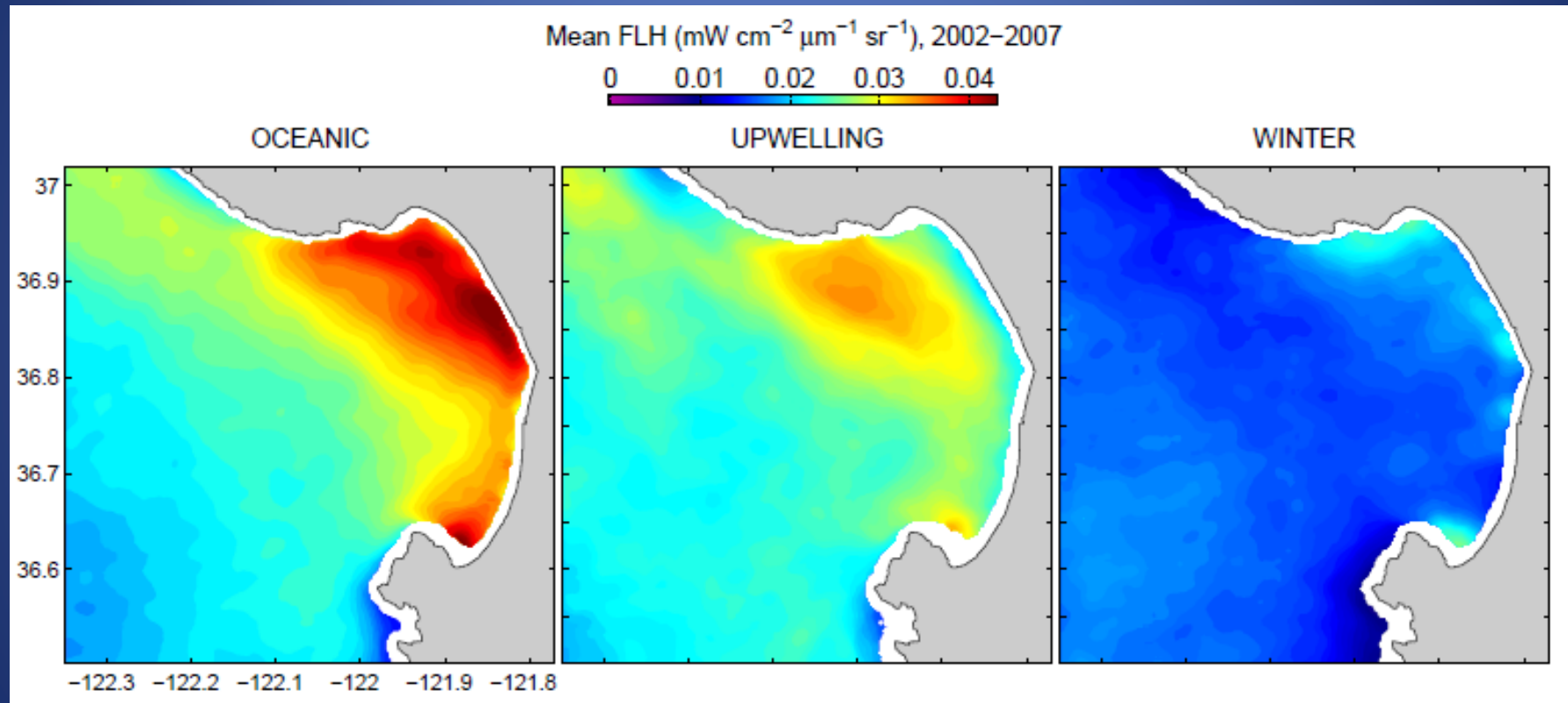


Ryan et al., 2010

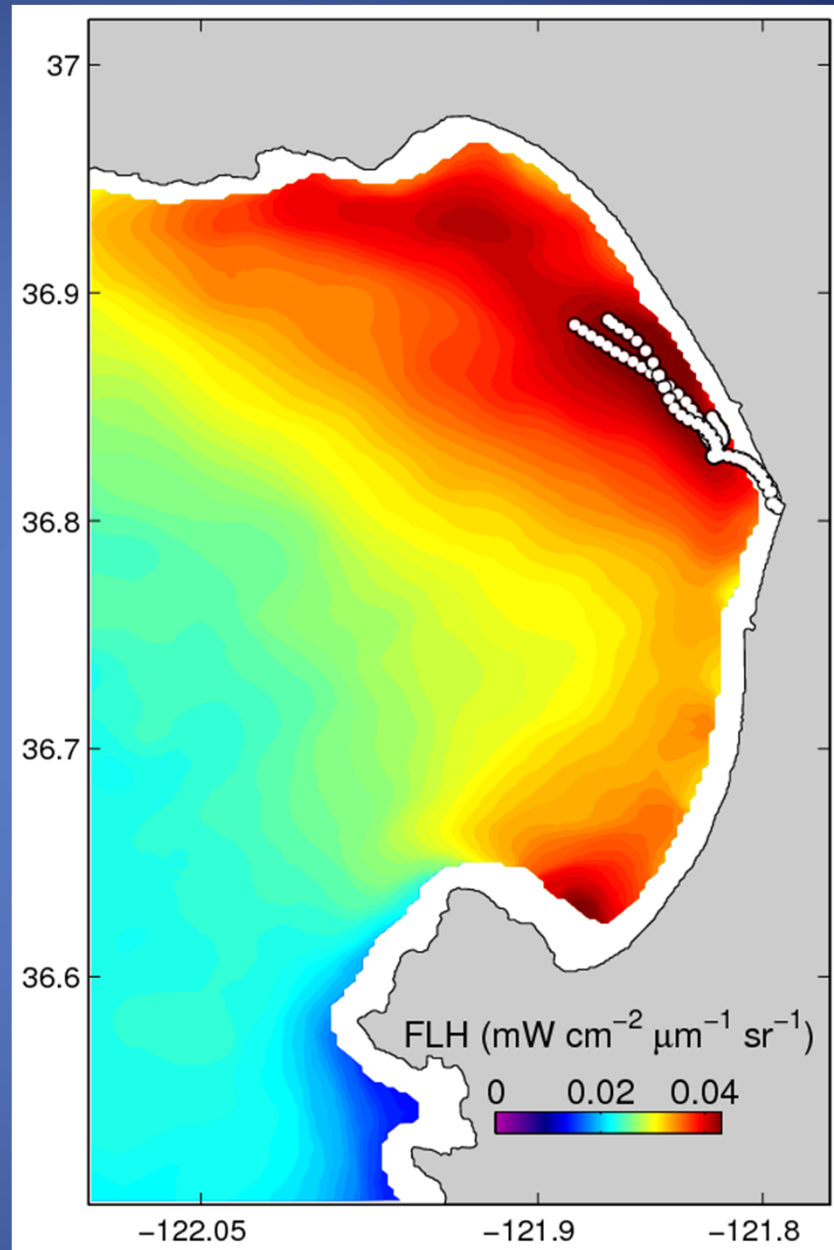


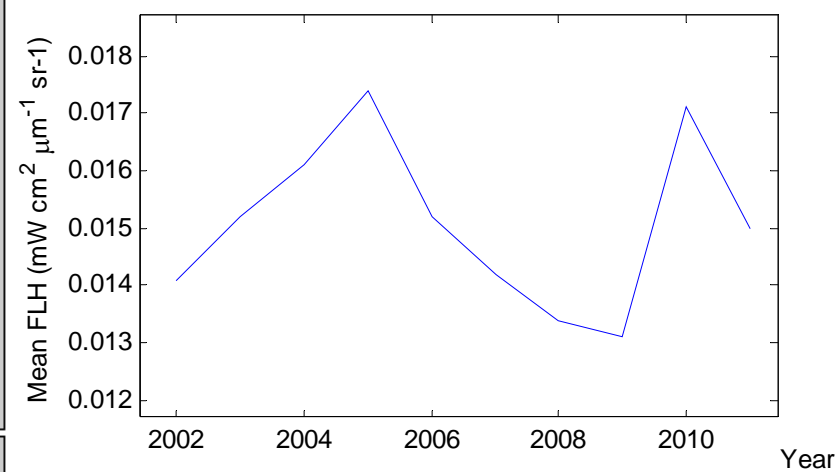
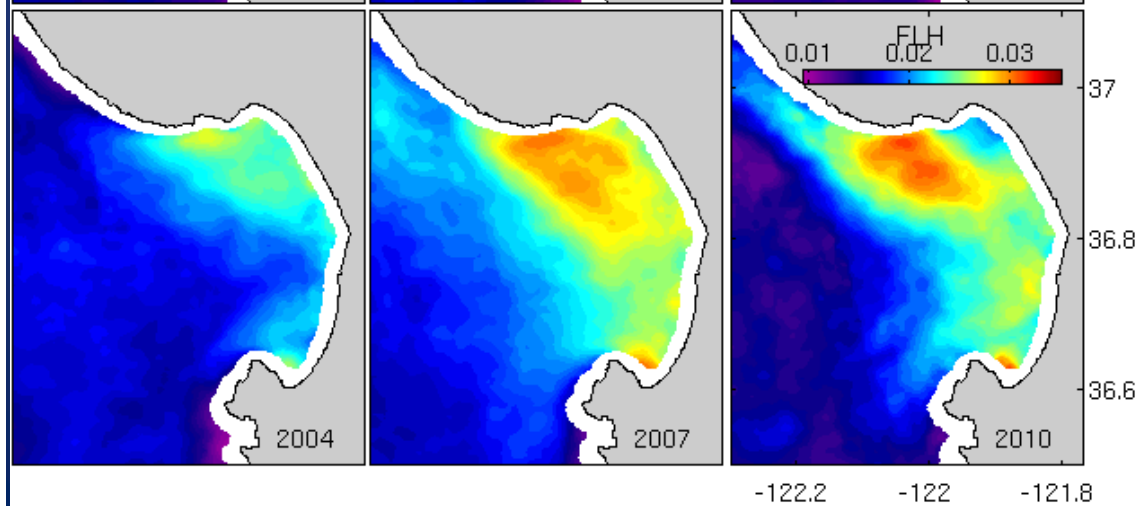
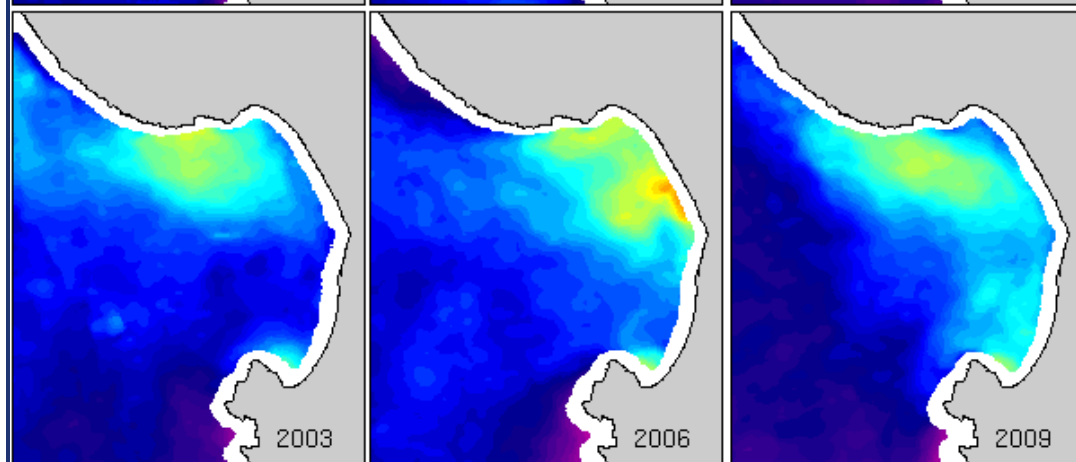
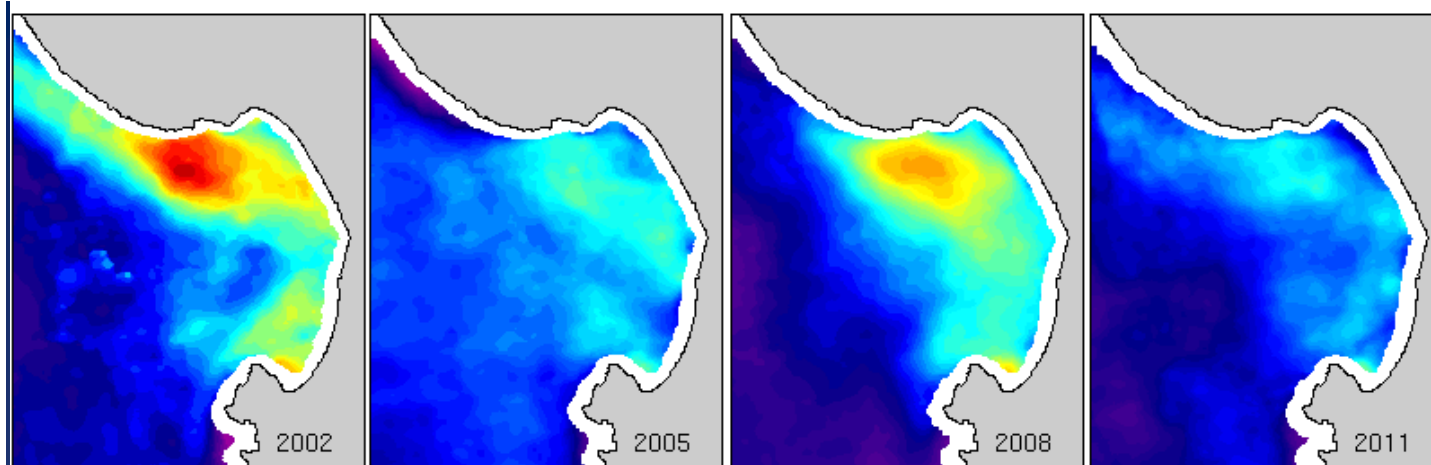
Ryan et al., 2008

Seasonal Means



FLH mean 2002-2011





Summary – Tampa Bay

- Highly variable correlation between FLH and in situ chl-a in Tampa Bay, FL.
- Multivariate analysis shows domains within the Bay and water quality variables that may influence correlations with FLH.
- Significant declining FLH trend.

Summary - Monterey Bay

- FLH correlation with in situ chl-a does not improve with lower chl-a concentrations.
- FLH reveals oceanographic phenomena not visible in standard chlorophyll product
- Annual trend just barely significant and declining.